

DETAILED ACTION

Specification

The specification is objected to as failing to provide proper antecedent basis for the claimed subject matter. See 37 CFR 1.75(d)(1) and MPEP § 608.01(o). Correction of the following is required: the specification does not provide support for the pulse to pulse ratio of 5:1 to 2:1 as required in claim 12 (it includes the range of 2:1 to 1:20 further required in that claim). The specification also does not provide support for a thickness of more than 15 (and up to 20) micron as required by claim 13.

The use of the trademark ASTM has been noted in this application. It should be capitalized wherever it appears and be accompanied by the generic terminology.

Although the use of trademarks is permissible in patent applications, the proprietary nature of the marks should be respected and every effort made to prevent their use in any manner which might adversely affect their validity as trademarks.

Drawings

The drawings are objected to because the writing on the figures is not legible due to size and the grain of the figures. Additionally, the Figures (Graphs 1-6) that are incorporated into the specification should be referenced as drawings, additionally, these are objected to as not legible (the lighter colored points and the lines).

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended

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replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as “amended.” If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either “Replacement Sheet” or “New Sheet” pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Objections

Claims 24-31 are objected to under 37 CFR 1.75(c) as being in improper form because a multiple dependent claim should refer to other claims in the alternative only. See MPEP § 608.01(n). Accordingly, the claims 24-31 not been further treated on the merits.

It is further noted that claim 24 depends on itself and 26 does not end with a “.”.

Claims 1-3, 10-15, 18 and 26 are objected to because of the informalities as noted below. Appropriate correction is required.

Claim 1 requires the a process time "sufficient" to create a layer – while sufficient is definite because it describes a process time, it nonetheless does not further limit process time in any capacity. The process time adds no limitations to the claim since a compound layer is formed regardless of the time frame limitation.

Further regarding claim 1, while the supply of the reaction gases will be interpreted as being supplied at a partial pressure that is less than atmospheric pressure, the limitation would be more clearly presented as "at a partial pressure which is less than atmospheric pressure", for example, and therefore is objected to.

Claim 3 should read "the total pressure of the mixture of reaction gases is".

Claim 10 would be more appropriately written as "the process time" per the wording in claim 1. Furthermore, "the reaction time" is unnecessarily repeated.

Claims 11 and 12 state "pulse pause ratio", but the term is not sufficiently defined. For clarification, the term should be changed to "pulse to pause ratio" or "pulse/pause ratio". Additionally, there is an extraneous "n" on ratio in claim 12. (In claim 24, the same ratio is referred to as "the pulse plasma on-to-off ratio").

Claims 13 and 14 would be better written as "micron" and not "microns"; alternatively, it could be written as "microns thick" instead of "thickness".

Claim 17 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper

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dependent form, or rewrite the claim(s) in independent form. Claim 15 would be understood to use a mixture of reaction gases as Ar, N₂, H₂ and CH₄ or comprising those gases. Under the first interpretation, claim 17 does not further limit claim 15, from which it depends.

Claim 18 does not end with a “.”.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-23 and 32-35 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Regarding claims 1-14 and 32-35, claims 1 and 32 requires a “substantial” compound layer and a “substantial nitrogen diffusion layer”. Because substantial is not being applied directly to any specific property of the compound layer, it is being held as indefinite. Substantial could refer to a composition or a thickness, as two exemplary interpretations.

Further, there is no specific guidance as to how thick particularly a nitrogen diffusion layer should be.

Claims 11 and 12 recite the limitation "the pulse" in regards to claims 1 and 3. There is insufficient antecedent basis for this limitation in the claim.

Claims 11 and 12 will be examined as depending from claim 3, so that antecedent basis requirements are met.

Further, a pulse to pause ratio including a "0" in the range to indicate the pause time does not constitute a pulsed plasma per claim 2 but rather a steady plasma. This is a distinct 112 rejection from the antecedent basis issue..

Claims 15-22 are rejected because it is not sufficiently clear which gases are required by claim 15. Claim 15 appears to indicate that Ar, N₂, H₂ and CH₄ are required, but claim 16 further limits the gases (though apparently required for claim 15). It is therefore indefinite which gases are required for claim 15, or, if any specific gases are required.

Regarding claim 34, a broad range or limitation together with a narrow range or limitation that falls within the broad range or limitation (in the same claim) is considered indefinite, since the resulting claim does not clearly set forth the metes and bounds of the patent protection desired. See MPEP § 2173.05(c). Note the explanation given by the Board of Patent Appeals and Interferences in *Ex parte Wu*, 10 USPQ2d 2031, 2033 (Bd. Pat. App. & Inter. 1989), as to where broad language is followed by "such as" and then narrow language. The Board stated that this can render a claim indefinite by raising a question or doubt as to whether the feature introduced by such language is (a) merely exemplary of the remainder of the claim, and therefore not required, or (b) a required feature of the claims. Note also, for example, the decisions of *Ex parte Steigewald*, 131 USPQ 74 (Bd. App. 1961); *Ex parte Hall*, 83 USPQ 38 (Bd. App. 1948); and *Ex parte Hasche*, 86 USPQ 481 (Bd. App. 1949).

In the present instance, claim 34 recites the broad recitation of a mixture of reaction gases per dependency on claim 1 but then in claim 34 is limited to only nitrogen. Claim will be interpreted necessarily broadly.

Claims 18 requires that "the said material is ASTM F-75 and ASTM F-75 Modified alloy" and claim 26 "the said cobalt chromium alloy is ASTM F-799, F75, and F75 modified. Because the ASTM materials have a particular composition, it is unclear exactly what material is being claimed in a "modified" alloy. As written, it is not clear if a material that doesn't truly meet the requirements of a F75 material could still be considered an F75 modified alloy.

Claim 23 is unclear. It will be examined as the final portion reading "incorporating plasma pulses of reaction gases which vary in on-to-off process levels".

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1, 3 and 33 are rejected under 35 U.S.C. 102(b) as being anticipated by Bell (WO03/093527).

Bell teaches a process for modifying a surface of a cobalt-chromium based alloy article (abstract). Bell teaches a method of exposure the alloy to a plasma at a pressure of 100 to 1500 Pa and temperature of 300 to 700 degrees C for 1 to 50 hours (p4, lines 19-28). The plasma includes a carbon containing gas (p4) (such as methane (p5, 5th para.) and also at least one other gas (including H₂ and/or Ar, p5, last paragraph), and furthermore may include nitrogen (p6, lines 1-9) thereby meeting the limitation of mixture of gases. At the taught pressure range, the gas mixture pressure is less than atmospheric.

Because the temperature range of the prior art is within the claimed range, examiner takes the position that the range is anticipated.

Regarding specifics of meeting the requirements of smoothness and hardness, Bell teaches forming a layer that improves the properties of hardness and wear resistance [0001]. While not specifically stating smoothness, examiner takes the position that the wear resistance is related to the smoothness and therefore this property is included in Bell's teachings. Furthermore, though Bell does not explicitly teach the result of improved smoothness (except through improved wear resistance), however, since the prior art and the present claims teach all the same process steps, the results of improving the hardness and wear resistance obtained by applicants process must necessarily be the same as those obtained by the prior art. Therefore by

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forming a layer by applying Ar, N₂, H₂, and CH₄ with a plasma in the temperature range of 300-700, it must necessarily result in improved smoothness by Bell. It is further noted that the instant claims put no specific limitations on "smooth" and the range of conditions to produce films of improved smoothness are not particularly limited (i.e. different gases, plasma or no plasma, pulsed or non-pulsed plasma).

Regarding claim 3, Bell teaches the instant pressure range as noted above.

Regarding claim 33, Bell teaches the use of glow discharge plasma (p11 2nd paragraph).

Claim 1 is rejected under 35 U.S.C. 102(b) as being anticipated by Shetty (5,308,412).

Shetty teaches a process for the formation of a chromium nitride layer on a cobalt-chromium-molybdenum alloy (abstract, col 2, lines 18-34). Shetty teaches that the substrate is placed in an apparatus, the apparatus is pumped down to subatmospheric pressure and then heated to 1300 degrees F (col 4, line 64 - col 5, line 29). (The process further comprises raising the chamber pressure).

In regards to the mixed gas, Shetty teaches that N₂ may include some argon and/or other gases (col 4, line 64 – col 5, line 12).

Regarding the method being a method for enhancing the surface hardness and smoothness of the cobalt-chromium alloys, Shetty describes the process as enhancing the hardness and the control of the CrN layer to effect a film that has enhanced wear

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properties - examiner takes the position that Shetty is describing a smoother film (col 2, lines 25-34).

The examiner takes the position that the teachings of Shetty are for formation of a layer of CrN – while Shetty teaches the avoidance of formation of a “substantial CrN” layer as to avoid certain expected negative qualities (col 2, lines 24-30), it is the examiner's position that Shetty teaches formation of a compound layer. While the subatmospheric step does not actually result solely in the formation of the layer, the subatmospheric step is within the process described of forming the layer. Instant claim places no limitations on additional processes being used to form the compound layer.

Claims 1, 3-9, and 13-22 are rejected under 35 U.S.C. 102(e) as being anticipated by Dunsmore (2005/0164041).

Dunsmore teaches a method for treating the surface of a medical device to produce a hardened layer of chromium nitride (abstract). The process includes applying a gas including nitrogen at a pressure of less than an atmosphere to a surface of a body comprising cobalt and chromium at 250 to 1000 degrees C [0024]. The process is described as creating a smooth, hardened surface. The reaction gas is preferably a mixture of nitrogen, argon, and hydrogen [0028].

Because the temperature range of instant application and the prior art are the same as described, examiner takes the position that the range is anticipated.

The steps form a chromium nitride layer on a chromium-cobalt composite and therefore meet the limitation of "compound layer".

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Regarding the limitation related to "sufficient time", examiner takes the position that since Dunsmore teaches forming a useful layer, it is inherently a "substantial compound layer".

Regarding claims 3, 20 and 21, Dunsmore teaches reaction gas pressure of 2-4mbar [0028].

Regarding claims 4 and 19, temperature range is met per the range above, and further, Dunsmore teaches a specific process where the temperature is maintained between 450 and 600 degrees C [0030], thereby anticipating claimed range.

Regarding claims 5, 6 and 16, the gases are taught per above.

Regarding claims 7, 8 and 17, Dunsmore teaches further adding methane [0028].

Regarding claim 9, Dunsmore teaches an embodiment where the process is carried out for 3-6 hours [0030].

Regarding claims 13 and 14, Dunsmore teaches 3-15 micron [0032].

Regarding claim 15, all requirements are met per above, the temperature requirement not being required, but taking into account the gas limitations per claim 7.

Regarding claims 18 and 22, Dunsmore teaches the use of ASTM F75 type materials [0003] as the type of alloys used as substrates.

Claim 23 limitations are met per above, not requiring temperature or pressure limitations. Further, Dunsmore teaches the optional use of a pulsed plasma [0029].

Regarding claims 34 and 35, since nitrogen is the gas which is incorporated into the material (i.e. to form a nitride layer), examiner takes the position that the inclusion of

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argon and hydrogen are not truly reaction gases in that, though they are present, they are not directly incorporated into the material.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 2, 10-12, and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dunsmore (2005/0164041) as applied to claim 1 above.

Regarding claim 2, Dunsmore teaches the limitations of claim 1 as noted above, and teaches the optional use of a pulsed plasma [0029]. While not specifically teaching a “glow discharge”, examiner takes official notice that the specific use of a glow

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discharge would be obvious plasma to apply to the invention based on the teaching of a plasma and the prevalence of glow discharge plasmas.

It would have been obvious to someone of ordinary skill in the art at the time of the invention to apply the use of a glow discharge plasma as the plasma applied by Dunsmore as glow discharge plasmas are a well-known method of plasma production when applying a voltage to a chamber/substrate as Dunsmore teaches [0029]. With the application of voltage, one could apply a glow discharge with a reasonable expectation of success in forming the plasma as taught by Dunsmore, based on the prevalence of glow discharge plasmas.

Regarding claim 10, Dunsmore teaches the use of a first and second stage, where the first stage may be about 4 hours [0030] and the second stage 10-20 hours [0031]; when applying the second stage at 20 hours, the total time is about 24 hours. Examiner holds that Dunsmore therefore teaches embodiments wherein the reaction time is 24 hours. It would have been obvious to someone of ordinary skill in the art at the time of the invention to apply a reaction time of 24 hours as described by Dunsmore with a reasonable expectation of success in forming a useful chromium nitride layer.

Regarding claims 11 and 12, Dunsmore teaches a ratio of on to off pulses of 2:5 [0029], thereby meeting the requirements of instant claims.

Regarding claim 32, Dunsmore teaches the control of properties to avoid further diffusion of nitrogen into the substrate after an initial growth layer [0031]. Examiner holds this to make obvious of one of ordinary skill in the art the desire to avoid too thick of a nitrogen diffusion layer.

Claims 4 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shetty (5,308,412) as applied to claim 1 above.

Regarding claim 34, Shetty teaches the use of pure nitrogen which is interpreted as nitrogen is the reaction gas (col 5, lines 5-12), while Shetty describes a maximum amount of impurities may be present the teaching is of pure nitrogen as the reactant.

Claims 2, 10, 11 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bell (WO03/093527) and in further view of Blawert (Surf and Coatings Tech.).

Regarding claim 2, the teachings of Bell are described above, teaching of plasma and also alluding specifically to glow discharge plasma (p11 2nd paragraph), but not specifically teaching the use of pulse plasma.

Blawert teaches the surface treatment of a nitriding treatment of a chrome steel alloy and teaches that pulse plasma is one method of nitriding (Introduction).

It would have been obvious to someone of ordinary skill in the art at the time of the invention to apply the use of a pulse plasma nitridation in the method of Bell as taught by Blawert as the pulsation of the plasma would allow a lower treatment temperature (Intro, Blawert). Examiner takes the position that the lowering of temperature is generally an accepted benefit for processes – but the lowering of temperature is presented by Blawert specifically as an advantage.

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Regarding claims 10 and 11, examiner takes the position that Bell teaches that temperature and gas composition (p6, 1st para) as well as the plasma producing power (p11, lines 1-18) are results effective variables, it would be further obvious to optimize the pulse on and off periods in order to effect an optimum protective layer when applying the pulsation of Blawert to the plasma of Bell.

Regarding claim 23, all the limitations are taught above per claims 1 and 2.

Claims 4-10, 13-22, 32 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bell (WO03/093527) as applied to claims 1 and 3 above.

Regarding claims 4 and 19, Bell teaches a preferable temperature range of 400 to 500 degrees C. (p5 1st paragraph), thereby making obvious the use of temperatures in the claimed range to form protective layers on Cr-Co substrates.

The requirement of claim 19 that the temperature is "held" does not add any further limitations without the specification of a particular time frame.

Regarding claims 5-8 and 35, as described above, Bell teaches the exposure of the alloy substrate to a mixture of gases which include N₂, H₂, methane and Ar.

While not specifically teaching an embodiment utilizing the claimed groups of gases, Bell makes the use of those gases obvious.

It would have been obvious to someone of ordinary skill in the art at the time of the invention to apply the use of Ar, N₂, H₂ and also with CH₄ with the expectation of success in forming a surface-improving layer on a Co-Cr alloy. Specifically regarding claims 5 and 6, which do not include CH₄, Bell teaches that it is known in the prior art to

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form such a layer without the inclusion of a carbon-source (p3 - p4) but teaches an improvement by including carbon. Examiner therefore takes the position that such a teaching of Ar, N₂, H₂ is made obvious.

Regarding H₂ as a carrier gas per claim 35, examiner takes the position that though Bell does not specifically teach that hydrogen is a carrier gas, it is taught as a non-reactive gas and is therefore interpreted as such.

Regarding claims 9 and 10, Bell teaches a reaction time of 5 to 30 hours, thereby meeting instant limitations. Bell's range includes embodiments wherein the reaction would occur for 24, and therefore It would have been obvious to someone of ordinary skill in the art at the time of the invention to apply any time frame, including 24 hours, with an expectation of forming a successful protective layer.

Regarding claims 13 and 14, Bell teaches a protective layer thickness of 3 to 50 micron (p7, 3rd para).

Regarding claims 15-17, all elements are taught above, per claims 1 and 5-8.

Regarding claims 18 and 22, Bell teaches the use of the named ASTM alloys as substrates (p7, last para).

Regarding claims 20 and 21, Bell teaches a method of exposure the alloy to a plasma at a pressure of 100 to 1500 Pa.

Regarding claim 32, the defined creation of a diffusion is not particularly limited, examiner takes the position that the layer of Bell being only 3 to 50 microns is not forming a substantial nitrogen diffusion layer. Further, Bell teaches formation of a

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carbon diffusion layer (p14) and that it is known in the art to avoid a substantial nitrogen diffusion layer (para on pg3-4). Bell teaches that the control of process conditions such as plasma effect the manner the gases diffuse into the substrate (para on pg 11/12) and therefore one of ordinary skill could optimize the process conditions to optimize the diffusion layer thickness and form a 'non-substantial' nitrogen diffusion layer.

Regarding claim 34, Bell teaches that nitrogen may be used as the reactive gas, other gases are optional (though preferred) (p5 last para, p6 1st para). As Bell teaches, nitrogen may be used as a reactive gas – though not specifically teaching an embodiment employing only nitrogen, examiner takes the position that Bell's teachings make obvious that nitrogen may be the gas used as a reactive gas with none of the other named gases. In the cited paragraph, Bell specifically teaches that nitrogen may be incorporated into the film. In the background, Bell teaches that the use of protective nitrogen layers is known. Examiner therefore takes the position that to use such a known component (nitrogen) via the method of Bell is made obvious - one could apply nitrogen as taught by Bell with a reasonable expectation of success in forming a protective layer on a Cr-Co substrate.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JOSEPH MILLER JR whose telephone number is (571) 270-5825. The examiner can normally be reached Mon - Thurs, 7am to 6pm.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks, can be reached on 571-272-1423. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/JOSEPH MILLER JR/
Examiner, Art Unit 1715

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Supervisory Patent Examiner, Art Unit 1715